Part V
Seismic Safety Element
San Diego County General Plan

Adopted
January 9, 1975
Amended
April 24, 1991
GPA 91-SE

1. **INTRODUCTION**

STATE MANDATE

In response to State Law the County of San Diego has included a Public Safety Element and a Seismic Safety Element in its General Plan since 1975. In 1984 the Government Code (Section 65302g) was amended to require that the Seismic Safety Element be consolidated with the Safety Element.

The California Government Code (Section 65302g) states that:

> "The general plan shall include a safety element for the protection of the community from any unreasonable risks associated with the effects of seismically induced surface rupture, ground shaking, ground failure, tsunami, seiche, and dam failure; slope instability leading to mudslides and landslides; subsidence and other geologic hazards known to the legislative body; flooding; and wildland and urban fires. The safety element shall include mapping of known seismic and other geological hazards. It shall also address evacuation routes, peakload water supply requirements, and minimum road widths and clearances around structures, as those items related to identified fire and geologic hazards."

While State Law requires the Safety Element to cover earthquakes, flooding, and fire; it also allows local jurisdictions to include other locally relevant safety issues such as noise, air quality, high winds, crime, civil disorder, acts of war, emergency medical services, etc.

TYPES OF HAZARDS

San Diego County's Safety Element covers seismic safety, flooding, fire, geological hazards, crime prevention, and emergency services. Material on the Seismic Safety portion is updated and expanded, while the sections on fire, geologic hazards, crime, emergency services and flooding are retained form the previous element without change.

The section on Seismic Safety has been updated first for two reasons:

1. An earthquake is the type of major disaster most likely to affect a large area of the County.

2. Preparation for and response to a major destructive earthquake requires consideration of other safety topics such as fire, civil disorder, emergency medical service, etc.

OBJECTIVES

The basic objective of the Safety Element is to identify and evaluate hazards confronting the County of San Diego and to establish policies to guide efforts to minimize the risk from these hazards. The intent of the policies is to reduce the loss of life, property damage, and social and economic dislocations in the event of a disaster.

GOALS

THE BASIC GOALS OF THE COUNTY OF SAN DIEGO IN ADOPTING THE SAFETY ELEMENT OF THE GENERAL PLAN ARE TO:

- MINIMIZE INJURY AND LOSS OF LIFE;
- MINIMIZE DAMAGE TO PUBLIC AND PRIVATE PROPERTY;
- MINIMIZE SOCIAL AND ECONOMIC DISLOCATIONS RESULTING FROM INJURIES, LOSS OF LIFE, AND PROPERTY DAMAGE.

OBJECTIVES

The objectives of the County of San Diego in adopting this element of the General Plan are:

- To define the relative degree of risk in various parts of the planning area so that this information will be used as a guide for minimizing or avoiding risk for new construction, and for risk abatement for existing development.
- To minimize the risk to human life from structures located in hazardous areas.
- To provide a basis for designating land uses which are appropriate to the risks of the various portions of the planning area.
- To ensure that facilities whose continuing functioning is essential to society, and facilities needed in the event of emergency, are so located and designed that they will continue to function in the event of a disaster.
- To facilitate post-disaster relief and recovery operations.
- To increase public awareness of hazards, and of means available to avoid or mitigate the effects of these hazards.

2. **RISK**

RISK CONCEPT

The idea of risk evaluation is the central concept in planning for safety. The concept can be applied to all kinds of hazards, both natural and man-made. The general idea is to first determine the degree of risk, secondly to decide how much risk is acceptable, and then implement measures to reduce the negative effects to a lower level.

LEVEL OF RISK

The degrees of risk are defined as follows:

- Acceptable Risk: The level of risk below which no specific action by government is deemed to be necessary.
- Unacceptable Risk: The level of risk above which specific action by government is deemed to be necessary to protect life and property.
- Avoidable Risk: A risk which need not be taken because individual or public goals can be achieved at the same, or less, total "cost" by other means without taking the risk.

The term "acceptable risk" is used to describe the level of risk that the majority of citizens will accept without asking for governmental action to provide protection. To illustrate this point: consider a site which is subject to occasional flooding. If the chances are one in a thousand that the site will be flooded in any given year, local citizens will probably accept that risk without asking for special protection. If the chances of flooding are one in ten, however, either governmental regulations would be enacted to keep people from building on the site (in order to protect life and property), or property owners would ask that government build protection devices to control the flood waters.

To determine levels of acceptable risk is to provide an answer to the question, "How safe is safe enough?" No environment is perfectly hazard-free. Natural and man-made hazards of some kind are always present, especially in urban environments. However, some hazards cause only minimal loss or occur so rarely that they need not be planned for at the community level.

On the other hand, some events occur often enough, or are large enough, and have the potential for major disruption of the community such that a community wide response to natural hazards such as earthquakes is a public responsibility which involves making a judgment, either explicit or implicit, about acceptable risk. Scientific expertise can determine the magnitude of the hazard and estimate the probable effects, but it cannot decide for the public how much risk to assume (or not assume) by planning for loss-reduction.

An important concept used in determining levels of acceptable risk is the idea of looking at events in terms of magnitude and frequency. The magnitude of an event refers to its size. Examples are the height of flood waters, the rating of an earthquake on the Richter scale, or the number of acres burned in a wildland fire. The frequency of an event refers to the number of times it occurs during a certain period of time. There is generally an inverse relationship between magnitude and frequency. That is, the less often an event occurs, the greater is its size and potential impact. For example, rainstorms occur annually in San Diego, but usually they are moderate storms and pose no serious threat. However, on rare occasions, as in 1916, a storm of large magnitude hits the area causing floods, property damage, and loss of life. The same concept applies to earthquakes. Small earthquakes occur every day in California, but there have been only ten really large quakes (7.0+) which have affected California citizens in the last 220 years.

The magnitude-frequency concept is involved in decisions regarding acceptable risk in that the community must judge the magnitude of an event for which to plan. The judgment is based in part on the frequency or recurrence interval of the hazardous event.

Another concept involved in planning for disaster is the idea that 100 persons killed in one building collapse or fire is seen as a disaster, whereby 100 persons killed in 100 separate accidents is not viewed as a disaster.

<u>ESSENTIAL FACILITIES</u>

The determination of acceptable risk from hazardous events also involves differentiating among man-made structures according to their potential effect on the loss of life and their importance in terms of emergency response and continued community functioning. If essential services are not functional after a disaster, the magnitude of the disaster can be much larger.

In the 1906 San Francisco earthquake the fire chief was injured, fire stations damaged, and water lines broken, with the result that the ensuing fire was much more of a disaster than the original earthquake. In the hours immediately following the 1971 San Fernando earthquake in Southern California, emergency services were impaired by damage to police and fire stations, communication networks and utility lines. Additionally a number of major hospitals in the area were damaged seriously and were unable to continue functioning at the time they were needed most.

These facilities and others are vital to the community's ability to respond to a major disaster and to minimize loss of life and property. The experience in San Fernando emphasizes the need to provide these "essential facilities" with a higher level of protection from earthquakes than non-essential structures. As a minimum, all structures which could have a significant effect on the loss of life should be designed to remain standing in the event of a major disaster, even if rendered useless. "Essential facilities", on the other hand, should not only remain standing, but in the event of a disaster should be able to operate at peak efficiency.

Because of the importance of critical facilities during a disaster, they will be discussed at greater length in a different section of the Safety Element.

POLICIES ON RISK

It is the Policy of the County of San Diego to:

1. Control uses of land to avoid exposing people and property to unacceptable levels of risk.

2. Locate areas and sources of risk, and make this information available to the public.

3. Discourage expansion of existing development and construction of new development, especially essential facilities, in localities exposed to hazards unless the hazards can be mitigated to the satisfaction of responsible agencies.

4. Scale the type of development to the amount of hazard present and to the level of risk which is acceptable for that development.

5. Reduce the amount of risk to which existing development is subject by requiring measures to reduce the risk. Such measures include building occupancy limitations, renovation, and demolition.

3. **SEISMIC SAFETY**

RELATIONSHIP TO OTHER SAFETY PROBLEMS

A destructive earthquake is the most likely type of major disaster to occur in San Diego County. Other types of disasters such as fire, explosion, or even flooding would be limited in area. A major earthquake, on the other hand, could disrupt the entire region. Furthermore, an earthquake disaster can create other kinds of problems such as dam failure, fire, civil disorder, and hazardous materials spills. Hence a disaster plan adequate for a major earthquake can also serve as a guide for dealing with disasters of lesser scope.

LEVEL OF RISK

The first question to ask is how big a problem is seismic safety? Or, how big an earthquake can we expect? How often? When and how much damage can be expected? What kind of emergency responses will be required? While no concise answer can be given, the state of the art has advanced enough that reasonable predictions can be made.

There is a perception that since San Diego has experienced no really large earthquakes within historic times, it is safe from earthquakes and is an "island" of moderate earthquake activity surrounded by a zone of high activity. It should be noted that the period of historical record (approximately 200 years) is too short to provide a representative sample of the type of earthquakes one can expect in the future. Furthermore, in this time period there have been seven earthquakes strong enough to cause damage in some part of San Diego County. The sizes and sources of most of these earthquakes are poorly documented due to the low population density and lack of instrumentation but recently discovered geological evidence indicates that San Diego County will be subject to damaging earthquakes in the future.

CAUSE OF DAMAGE

Most of the damage and loss of life from an earthquake is caused by the collapse or partial failure of buildings and other structures, during the shaking. There are, however, other effects of an earthquake which sometimes also cause serious damage, such as rupture of public utilities built on or across faults, earthquake induced landslides, inundation due to dam failure, liquefaction of soil, and the sloshing of liquid in reservoirs or tanks. Each of these subjects will be discussed in a separate section.

ACHIEVEMENT OF SEISMIC SAFETY

Although earthquakes cannot be prevented, the amount of damage and injury occurring during a major earthquake can be drastically reduced by preparation. The first step is to increase awareness that earthquakes will occur, and that actions can be taken to reduce the damage.

A number of things that can be done are listed below.

- Future development can be made more safe by strict enforcement of current building standards and new development can be located so as to avoid the most hazardous areas.

- Existing unsafe buildings and structures can be made safer by well established techniques of reinforcement.

- Essential structures - those needed during an emergency and those high occupancy structures whose failure would kill or injure many people must be constructed (or reconstructed) to a higher standard.

- Each individual, agency, and company must be prepared ahead of time, for quick and effective response at the time of an earthquake. Each of these subjects is discussed in a separate section.

4. **GROUND SHAKING**

SIGNIFICANCE

In terms of human and economic losses, ground shaking is the most significant hazard from earthquakes. In most severe earthquakes the deaths, injuries, and property damage are caused by collapse of poorly constructed or improperly maintained buildings and structures.

MAGNITUDE AND INTENSITY

The size of earthquakes are measured by two scales: Magnitude and Intensity. Magnitude is an indirect measure of the amount of energy released at the earthquake's source (usually a fault) and is measured on the Richter scale. This scale is logarithmic. An earthquake of magnitude 7 represents the release of approximately 30 times as much energy as one of magnitude 6. (See figure 1.)

The damage caused by an earthquake is measured on an entirely different scale, the Modified Mercalli Intensity Scale. Intensity is a measure of the actual effects on the ground, on people, and on structures at any given locality. Intensity is measured on a scale of I to XII, with I representing an earthquake that is felt by very few people, and X representing an earthquake strong enough to destroy some well-built structures. (See Table 1 for the Modified Mercalli Intensity Scale.) Generally significant damage starts at an intensity of VII, and is associated with an earthquake of magnitude 5.0 or greater.

FIGURE 1. RELATIONSHIP BETWEEN EARTHQUAKE MAGNITUDE AND ENERGY

The volumes of the spheres are roughly proportional to the amount of energy released by earthquakes of the magnitudes given, and illustrates the exponential relationship between magnitude and energy. At this same scale the energy released by the San Francisco earthquake of 1906 (M=8.3) would be represented by a sphere with a radius of 110 feet.

Table 1

MODIFIED MERCALLI INTENSITY SCALE

I Not felt except by very few under especially favorable conditions.

II Felt only be a few persons at rest, especially on upper floors of buildings.

III Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration like passing of truck. Duration estimated.

IV During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck passing building. Standing motor cars rock noticeably.

V Felt by nearly everyone; many awakened. Some dishes, windows, etc., broken; a few instances of fallen plaster of damaged chimneys. Damage slight.

VI Felt by all; many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster of damaged chimneys. Damage slight.

VII Everyone runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly build or badly designed structures; some chimneys broken; noticed by persons driving motor cars.

VIII Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motor cars disturbed.

IX. Damage considerable in specially designed structures; well design frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.

X. Some well-built structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.

XI Few if any masonry structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.

XII Damage total. Waves seen on ground surface. Lines of sight and level distorted. Objects thrown into air.

In a magnitude 7+ earthquake there is a strongly-felt, swaying ground motion many miles from the source or "epicenter." Motion could be felt over an area as large as the entire State of California in a major earthquake.

Some factors which determine the amount of damage that will occur during an earthquake are:

- o Magnitude of energy released and seismic wave frequency;
- o Distance from source;
- o Way in which the ground at a site responds to seismic waves;
- o Way in which a building at a site responds to seismic waves.
- o Duration of ground shaking.

HISTORICAL EARTHQUAKES

In the last 220 years there have been nine major earthquakes in California. Some of these caused little damage because they were centered in remote area or occurred at a time when California population was very low. The largest and most famous major historical earthquake was the 1906 San Francisco event, where most of the damage was caused by the subsequent fire.

The historical record shows that even moderate sized earthquakes (agnitude 6.0 to 6.9) also can cause major damage and loss of life if they occur close to an urban area. Since 1800 there have been approximately sixty earthquakes of this size in California. Of the 20 some earthquakes over magnitude 6.0 that have affected Southern California in the last 65 years the following 5 have been close enough to urban areas to cause significant damage.

YEAR	LOCALITY	DAMAGE	DEATHS	MAGNITUDE (M_L)**
1925	Santa Barbara	$ 8,000,000*	13-20	6.3
1933	Long Beach	40,000,000	120	6.3
1971	San Fernando	443,000,000	64	6.4
1979	El Centro	21,000,000	0	6.6
1987	Whittier	358,000,000	1	5.9

* Figures not adjusted for inflation.
** All magnitudes in this report are stated as local magnitude (M_L). Other reports may use different kinds of magnitude, which vary somewhat from local magnitude.

HISTORICAL EARTHQUAKES AFFECTING SAN DIEGO COUNTY

The historical seismicity of the San Diego region is low compared to the rest of Southern California. This may be due to San Diego being on a more stable block or it may only be a reflection of a period of historical record which is too short to be meaningful.

San Diego County has experienced strong shaking and damage from several earthquakes, but none of the recent ones have been particularly destructive. However, the earthquake of February 23, 1892 had an intensity of VII in the City of San Diego and in the eastern part of the County. Most of these earthquakes apparently originated at long distances from San Diego, generally in the Imperial Valley or northern Baja California.

Historical records reveal damaging earthquakes in the San Diego region during 1800, 1812, and 1862. Although it is impossible to accurately identify the faults associated with the quakes, it is possible that the 1800 and 1862 earthquakes occurred on one of the coastal faults perhaps, the Rose Canyon or Coronado Bank fault. The 1812 earthquake was on the San Andreas fault. The earliest recorded damaging earthquake in the San Diego area was on November 22, 1800 which had an estimated 6.5 magnitude. This earthquake damaged both the San Diego and San Juan Capistrano Missions. In 1890 and 1899 the San Jacinto fault produced quakes stronger than 6.0 magnitude. In 1910, the Elsinore fault produced a 6.0 magnitude quake and its southern extension the Laguna Salada fault has a very conspicuous scarp probably created during a major earthquake. The San Clemente fault was responsible for a 5.9 magnitude quake in 1951.

The 1968 Borrego Earthquake on the San Jacinto fault is the only one which occurred recently enough to be well documented. It was a moderate sized earthquake (magnitude 6.5) centered in a remote area. It destroyed some poorly built houses in Ocotillo Wells (Intensity VIII) and caused minor damage in most parts of San Diego County, including some collapse of sea cliffs on Point Loma.

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GEOTECHNICAL ANALYSIS

Because earthquakes originating on any one fault occur at widely spaced intervals, the period of record in San Diego County is too short to use as a reliable basis for accurate predictions of the intensity and frequency of future earthquakes. Instead it is necessary to rely on a method of scientific analysis to estimate the size of future earthquakes.

This process involves several steps:

- Identification of active faults;
- Determination of estimated maximum size of earthquakes for each fault;
- Calculation of recurrence interval for the various levels of anticipated earthquake on each fault;
- Preparation of an intensity map for the earthquakes;
- Prediction of local effects due to the characteristics of the ground.

IDENTIFICATION OF ACTIVE FAULTS

Active faults are located and mapped based on offset geologic units, alignment of canyons, springs, surface and submarine topography, and location of epicenters. All of the faults which could affect San Diego County are part of the San Andreas system of faults.

The portion of California west of San Andreas fault is part of the Pacific plate and is moving north with respect to the rest of the continent which is part of the North American plate. This movement is distributed among several faults in addition to the main San Andreas fault.

In and near San Diego County these other faults include the San Jacinto, Coyote Creek, Earthquake Valley, Agua Caliente, Elsinore, Rose Canyon, San Miguel (Mexico), Agua Blanca (Mexico), and Coronado Banks (off shore).

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SAN ANDREAS FAULT

The largest fault in the San Diego region, the San Andreas fault, is at least 800 miles long and is located 27 miles east of Borrego in the Coachella Valley. There is increasing concern that the 85 mile section from north of San Bernardino to the Salton Sea is overdue to rupture, having been "locked" for the last 200 years. Such an event could cause an 8.3 magnitude earthquake - the size of the 1906 San Francisco quake. An 8.3 event on the San Andreas would subject San Diego County of shaking of intensity VII to VIII, enough to cause considerable damage.

SAN JACINTO FAULT

The San Jacinto fault, a very active fault, cuts through the northeast corner of San Diego County, along the base of the Santa Rosa Mountains, on the east side of Borrego Valley. Since 1900 there have been six earthquakes greater than 6.0 on this fault. It is estimated that the probable event on this fault is on the order of magnitude 7.0. An earthquake of this size on the San Jacinto fault in San Diego County would cause severe damage in Borrego Valley and Ocotillo Wells, with moderate damage in the coastal area.

COYOTE CREEK FAULT

The Coyote Creek fault is a major branch of the San Jacinto fault. It runs along the base of the Coyote Mountains, four to five miles east of Borrego Springs, and through the community of Ocotillo Wells. The 1968 Borrego earthquake, magnitude 6.5, originated on this fault. Rupture on this fault could cause an earthquake of 6.9, which would cause considerable damage in Borrego.

AGUA BLANCA FAULT

The Agua Blanca fault cuts across Baja California about 61 miles south of the border, entering the Pacific Ocean south of Ensenada. It is a very active fault capable of generating a 7.7 magnitude earthquake. This would cause major damage in Ensenada and some damage in the Tijuana/San Diego area.

CORONADO BANK AND SAN DIEGO TROUGH FAULT ZONES

The Coronado Bank fault zone is a series of sub-parallel faults parallel to the coast about ten miles offshore and was the source of a magnitude 4.6 earthquake in 1983. It is estimated that a magnitude of 7.7 earthquake could be generated.

The San Diego Trough fault zone is similar to the Coronado Bank, but located about five miles further offshore. It also could possibly generate an earthquake of magnitude 7.7.

SAN CLEMENTE FAULT

The San Clemente fault is located about 40 miles offshore along the east side of San Clemente Island. It is 110 miles in length and was the source of a magnitude 5.9 earthquake in 1951. It is estimated that the maximum earthquake generated would be magnitude 7.7.

The frequency and magnitude of earthquakes generated by these offshore faults is difficult to estimate due to their inaccessibility. However, a 7.7 magnitude event close to the San Diego/Tijuana urban area would cause considerable damage

ELSINORE FAULT

East of San Diego the closest active fault is the Elsinore. It passes through the town of Elsinore, along the south side of Palomar Mountain, through Lake Henshaw, Santa Ysabel Indian Reservation, down Banner Canyon east of Julian, and out in the desert near Vallecitos. The Elsinore fault apparently joins the Laguna Salada fault on the east side of the Sierra Cocopah in Baja California.

The central portion of the Elsinore appears to be less active than the faults further east. The most active portions of the Elsinore fault are its northern end and the Laguna Salada fault to the south. The 1910 Temescal Valley earthquake (magnitude 6) was probably on the Elsinore fault in Riverside County.

The Elsinore fault is probably capable of generating an earthquake of magnitude 7.4. Depending upon which segment moved, considerable damage might occur in Escondido, Ramona, Julian, Borrego, and Jacumba. Portions of all of the roads to the east would probably be temporarily closed by landslides.

ROSE CANYON FAULT

The Rose Canyon fault zone is probably the most significant potential earthquake source in the San Diego urban area, not because it is a large fault, but because it is located under a populated area. Evidence from other areas indicates that a moderate earthquake can cause considerable damage if it is very close to an urban area.

The Rose Canyon fault zone extends from the sea floor off La Jolla Shores, on shore at La Jolla Cove, through Rose Canyon, along the east side of Mission Bay, and into San Diego Bay. In the bay the Rose Canyon fault appears to split into several faults--Spanish Bight, Coronado, and Silver Strand faults. Some of these faults appear to run under the bay toward San Ysidro. Others trend more southerly toward Imperial Beach and La Playa (west of Tijuana), both onshore and offshore. Together with the La Nacion fault zone, located several miles inland, they account for the main topographic features in the San Diego/Tijuana area.

The Rose Canyon fault zone is part of a larger system of discontinuous segments that extends northward to include the Newport-Inglewood fault zone. Because of the segmented nature of this system, a single event cannot rupture its entire length. Instead, separate portions rupture at different times. Such an event on the Newport-Inglewood fault was the source of the 6.3 magnitude 1933 Long Beach earthquake. This is an indication of the magnitude that can be expected from an event on the Rose Canyon fault.

Also along the same general trend as the Rose Canyon fault zone,but with a less clear association, is the Vallecitos-San Miguel fault zone to the south in Baja California. This fault zone was the site of four 1956 earthquakes of magnitude greater than 6.0 and one in 1949 greater than 5.7.

Although the largest historical event on the Rose Canyon fault zone, located near the south end of the San Diego Bay in 1985, has a recorded magnitude of 4.2, larger events are possible in the future. There was a magnitude 5.3 earthquake in 1986 west of Solana Beach on a possible offshore continuation of the Rose Canyon fault. Recent work near Interstate 5 and the Damon Avenue overpass, by Thomas Rockwell, and Scott Lindvall confirms that the zone is active. The estimated maximum magnitude on the Rose Canyon fault zone is on the order of 6.75 to 7.

The estimated recurrence interval for moderate to large earthquakes (magnitude 6 to 7) on individual strands of the Rose Canyon fault zone, from San Diego Bay to Camp Pendleton, range from 500 to 1000 years. Because the fault zone is comprised of several strands that have staggered recurrence intervals, the actual recurrence for an event in the overall zone is shorter. In addition, timing of the last occurrence on any one strand is unknown. Hence there is much uncertainty in forecasting the next major earthquake.

PREDICTED MAGNITUDES FOR DAMAGE SCENARIOS

Two faults that can be a major source of earthquake damage in San Diego County are the Elsinore Fault and the Rose Canyon fault. These faults are therefore used in developing damage scenarios for the area.

The Elsinore is used because it is the largest, clearly active major fault near San Diego. The Rose Canyon's fault's degree of activity is less well known, but is used because experience from a number of recent earthquakes has shown that even a moderate sized earthquake can cause considerable damage if its source is close to a population center.

An example of a damage scenario for disaster preparedness planning is presented in the study conducted by the California Division of Mines and Geology. The study assumed an earthquake of magnitude 6.8 originating on the Silver Strand fault, a branch of the Rose Canyon fault zone. An estimated recurrence period for this earthquake is about 300 years. The actual recurrence interval for the entire fault zone may be shorter due to staggering of the recurrence intervals of the individual strands.

For the purpose of developing a damage scenario, the maximum magnitudes on the order of 7 to 7.5 are used for the Elsinore fault.

SEISMIC ZONATION

For any given area the maximum amount of seismic energy anticipated depends on the magnitude of the largest likely earthquake and the distance to the earthquake source. But, the actual intensity (effect on buildings) also depends on the ground condition at the site.

Loose water saturated sediments can shake somewhat like jelly, amplifying the energy of the earthquake waves. In those areas the intensity will be higher and the destruction greater. Bedrock or well consolidated sedimentary rocks are much more stable. The best tool for predicting local intensities is a seismic zonation map, which shows detailed variations in expected intensity based on local geology. Preparation of detailed and accurate seismic zonation maps requires considerably more effort than ordinary geologic mapping. For each area the maximum anticipated earthquake energy has to be calculated, detailed geological maps prepared, and the physical properties of the underlying ground determined. This step involves mathematical analysis of bore hole information and/or analysis of responses to smaller earthquakes in order to prepare quantitative maps.

Although preparation of seismic zonation maps is time consuming and expensive, the result provides information that can be used directly in either building design or in evaluation of the safety of existing structures. The pioneer work in seismic zonation has been done in Japan.

PREDICTION AND WARNING

Several decades of research in the United States, Japan, China, and the Soviet Union have given seismologists some understanding of what kinds of changes in the earth precede an earthquake. In California seismologists and geologists believe they know which fault segments are due or overdue for an earthquake. Unfortunately, the state-of-the-art has not yet advanced far enough to make reliable, short-term earthquake predictions. Several faults in California, especially the San Andreas, are so highly instrumented that when the next big earthquake on one of these faults occurs, we will have a very accurate picture of what preceded that earthquake. Such information may well make prediction of the next large earthquake feasible.

The California Division of Mines and Geology and the Seismic safety

Commission have given a lot of thought on how to alert the population. If the U.S. Geological Survey believes that a major earthquake has some significant probability it will warn the California Office of Emergency Services which will in turn warn the San Diego County Office of Disaster Preparedness.

Because the art of earthquake prediction is in its infancy, it is likely that for a while there will be earthquakes with no warning and warning without earthquakes.

POLICIES ON GROUND SHAKING

It is the Policy of the County of San Diego to:

1. Develop accurate, detailed, and up-to-date information on historical and potential ground shaking intensities.

2. Encourage and support detailed studies of active faults to determine the frequency and magnitude of earthquakes.

3. Encourage and support investigation of influence of site conditions on ground shaking.

Action Programs

3.1 Compile detailed geologic maps and boring logs which can be used in preparation of maps showing influence of site conditions on ground shaking.

3.2 Provide data and drafting service to the California Division of Mines and Geology for their programs on influence of site conditions on ground shaking.

4. Require that the design of structures take into account the influence of site conditions on ground shaking of the foundation material at each site.

5. Regularly review and update the County Building Code to incorporate the most current seismic design standards and hazard-reduction measures from the Uniform Build Code (UBC) and other sources.

5. **FAULT RUPTURE**

Although by far the most damage caused by an earthquake is due to ground shaking; any buildings built right on an active fault are obviously in danger. If a building is built on a fault trace, any movement, fast or slow (fault creep), will rupture that building. This is a major concern in communities where very active faults such as the San Andreas, run through urbanized areas, such as include San Francisco, Portola Valley, Hayward, San Bernardino, and San Jacinto. In San Diego County, most of the known active faults in the unincorporated area are in relatively sparsely settled regions in the northeastern corner of the County. Portions of these faults are within Federal land (National Forest, Bureau of Land Management, and Indian reservations), and the Anza Borrego Desert State Park. In the coastal area the Rose Canyon fault is active and the La Nacion fault may possibly be active.

The State of California has designated Special Studies Zones along active faults in the following areas:

Elsinore fault: North of Pala, Palomar Mountain, Pauma Valley, Lake Henshaw, Julian, Banner Canyon, Mason Valley, Vallecito Valley, and Carrizo Valley.

Earthquake Valley fault: San Felipe Valley and Sentenac Canyon.

Coyote Creek fault: Borrego Valley and Ocotillo Wells.

San Jacinto fault: Clark Valley (east of Borrego).

In addition, the County has a responsibility to regulate development along the following active faults and areas which are not yet in Special Studies Zones.

Agua Caliente fault: Dameron Valley, Oak Grove, Sunshine Summit, Warner Springs and Ranchita.

Hot Springs fault: Chihuahua Valley

The State is currently (1991) studying the Rose Canyon fault with the intention of designating it as a Special Studies Zone.

The Alquist-Priolo Special Studies Zones Act of 1972 specifically addresses the problem of rupture on active faults. This act requires each jurisdiction to adopt an ordinance controlling development on or near active faults. San Diego County added Fault Displacement Area Regulations to its Zoning Ordinance (Sections 5400-5406) in 1979.

The State has designated Special Studies Zones, generally about one-fourth mile wide. They have provided the County with reproducible quadrangle maps showing these zones, and these maps are available to the public through the Department of Public Works. The State also recognizes that there are other active faults (Agua Caliente, Hot Springs, Earthquake Valley, etc.) in the County, but Division of Mines and Geology staff has not yet been able to accomplish the necessary geologic mapping.

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The County's Fault Displacement Area Regulations (Section 5404) prohibit structures with a capacity of 300 persons or more and all essential facilities in any Special Studies Zone. Section 5406 allows the County to require a geological report to delineate the exact traces of active faults within the Special Studies Zones. This requirement is implemented as part of the environmental review process under the California Environmental Quality act.

The Fault Displacement Area Regulations prohibit dwellings within 50 feet of an active fault trace. Single family homes which are part of a development of less than four dwellings are exempt from these regulations.

The County also applies its Fault Displacement Area Regulations in areas adjacent to active faults not yet designated by the State as part of the Special Studies Zones. This is done on a case-by-case basis and is part of the environmental review process.

<u>POLICIES ON FAULT RUPTURE</u>

It is the Policy of the County of San Diego to:

1. Prohibit construction of essential facilities and high occupancy structures in special studies zones as defined under the Alquist-Priolo Act (Sec. 5404, Zoning Ordinance) or in special studies zones defined by the County of San Diego.

2. Require a geologic report for other development proposed in special studies zones as defined under the Alquist-Priolo Act (Sec. 5406, Zoning Ordinance) or in special studies zones defined by the County of San Diego.

3. Prohibit new construction of structures to be used for human occupancy over or within 50 feet of the trace of an active known fault, with the exception of single family wood frame dwellings not exceeding two stories in height built or located as part of a development of less than four such dwellings and mobilehomes wider than eight feet (Sections 5406 c & d, Zoning Ordinance).

4. Delineate special studies zones along active faults as new geologic information becomes available. These special study zones shall be administered in the same manner as those delineated by the State of California.

<u>Action Programs</u>

4.1 Compile new information on geologic studies on active faults.

4.2 Recommend to the State of California that other faults found to be active be designated as Special Studies Zones.

6. **LANDSLIDES**

Landsliding is a type of erosion in which masses of earth and rock move down slope as a unit. There are several types of landslides:

- o Rotational slide in which the weight of the earth overcomes its strength and a mass of material slumps along a curved slide plane.
- o Block glide in which a mass of earth or rock slips along a pre-existing plane of weakness such as a clay seam or a fault plane.
- o Rock fall in which rock breaks away from a cliff or bank and falls.
- o Mudflow in which a mass of saturated soil flows downhill as a very thick liquid.
- o Dislodged boulders may roll down hill.

Most rock units are not homogeneous but are usually broken by planes of weakness. Landslide failure planes often follow these weak areas in bedrock. In sedimentary rocks these planes are often thin layers of clay parallel to the bedding. Granitic and volcanic rock, as well as sedimentary rock, may be broken by fractures and faults. These planes are often filled or coated with a thin layer of clay, and they provide access for percolating water which lubricates the clay and adds weight to the material.

On occasion, masses of otherwise stable rock may fail along such planes. The slides in the granitic rock of San Diego's back country usually involve material weakened by intersecting fracture planes and areas of weathered rock. These slides are often in gabbro, which breaks down more completely than ordinary granitic rock when it is exposed to air and water.

In the coastal portions of the San Diego urban area most landslides occur in certain landslide prone sedimentary formations: Ardath shale and the Friars, Mission Valley, San Diego, Otay, and Sweetwater formations. Landslides are common on the slopes of Otay Mesa, the east side of Point Loma, Mount Soledad, Rose Canyon, Sorrento Valley, Torrey Pines, Rancho Bernardo, Penasquitos, Fletcher Hills, and in Mission Gorge near the second San Diego Aqueduct.

In the mountains and deserts of San Diego County there are numerous landslides in the granitic and metamorphic rocks - rocks which most people would normally view as stable. On Highway 15, Highway 8, and Skyline Truck Trail, there are landslides that occurred along faults or fracture surfaces in granitic rock. There are also numerous natural landslides in the sheared granitic rock along the Elsinore Fault zone on the south flank of Palomar Mountain and in Anza Borrego State Park.

Finally, there are numerous natural landslides in the clayey soil and weathered gabbro of the Cuyamaca Mountains and Viejas Mountain.

There are four basic types of action which can trigger landslides in areas prone to this type of erosion.

- o Increasing the height of the slope by removing material from the bottom of the slope.
- o Raising the height of the slope by adding fill to the top.
- o Saturating the slope with water from septic tanks, gutter runoff or diverted drainage from another part of the slope.
- o Vibration during an earthquake.

During a major earthquake it is likely that landslides would occur simultaneously in the following problem areas.

- o Large landslides at Fort Rosecrans may damage portions of the Navy's anti-submarine warfare facilities.
- o Numerous landslides on Mount Soladad may damage property and block roads, possibly including some lanes of Highway 5.
- o Portions of the coastal bluffs may fail causing property damage and loss of life.
- o Landslides in the eastern portions of Tijuana and near the San Ysidro border crossing may cause damage, loss of life, and disruption of the highway and railway.
- o Rock falls and/or landslides are likely to block the Tijuana - La Playa Road.
- o Rock falls will temporarily block at least some lanes of Highway 8 on Mountain Springs Grade, Cantú Grade on Highway 1 in Baja California, and all of the routes to Borrego (Montezuma Grade, Yaqui Pass, and Banner Grade).
- o Major landslides are likely to completely disrupt portions of the toll road between Tijuana and Ensenada.
- o Some large boulders may roll down from hillsides onto houses at the base of hills.

<u>POLICIES ON LANDSLIDES</u>

It is the Policy of the County of San Diego to:

1. Compile, maintain, and make available to the public maps showing landslides and areas susceptible to landslides, mudslides, rockfalls, and similar geologic hazards.

2. Require a geologic report prepared by a certified engineering geologist on any development site where landslides or similar geologic hazards are known or suspected to exist.

3. Require, where evaluation indicates that a slope can be stabilized, that stabilization be a condition for development and that the foundation and earth work be supervised by a certified engineering geologist.

4. Prohibit alteration of the land in areas where there is a high potential for activation of landslides. Such alterations include excavation, filling, removal of vegetative cover; and concentrations of water from drainage, irrigation, or septic systems.

5. Prohibit development in areas of extensive landsliding where stabilization cannot reasonably be done.

6. Require provision of rock nets, fences, berms, or other features designed to prevent road blockage from rockfalls for single access routes to new developments.

7. **LIQUEFACTION AND OTHER TYPES OF SOIL FAILURE**

In addition to the direct effect of shaking on buildings, an earthquake can also affect the underlying foundation soils, causing damage to the structures built on these soils. Possible types of failure including liquefaction, elevation changes, and ground lurching. None of these is likely to be a severe problem in the unincorporated portion of San Diego County, but there could be some localized problems.

LIQUEFACTION

Liquefaction is caused by the vibration of loose fine sand or silt which is saturated with water. During an earthquake the solid particles in a shallow sedimentary layer have a tendency to decrease in volume due to ground shaking. This tendency causes an increase in pore pressure in the water between grains and considerable reduction in soil strength. In case of severe ground shaking the soils may flow like a liquid. Any building or structure built on the sediment may float, sink, or tilt - as if it were on a body of water.

Liquefaction only occurs if the sediment 1) is of fine sand or silt size, 2) is loosely consolidated, 3) is saturated, and 4) is subject to vibration. There are only limited known areas within the unincorporated portion of the County where liquefaction might possibly occur, such as the lower San Dieguito River Valley or that portion of Borrego Valley near Borrego Sink. There have been no geological investigations regarding the existence of hazards at these locations.

There are areas of construction on artificial fill over fine sediments around San Diego Bay which might be subject to liquefaction during an earthquake. The County has no jurisdiction over these areas, but would be involved in disaster response in the city.

SUBSIDENCE AND ELEVATION CHANGES

During an earthquake the slow process of compaction which occurs in loose soils or artificial fills may be accelerated by the vibration. While this effect is unlikely to cause building failures; it can cause a variety of small problems such a blocked drainage and broken utility lines. Any movement on faults, whether slow or sudden (earthquake), will distort property boundaries and survey lines.

GROUND LURCHING

During a major earthquake the sudden movement of the earth can cause ridges, fill slopes, and cut banks to fail. Widespread, minor damage would be expected at the edges of artificial fills, and widespread, temporary blockage of roads due to the collapse of road cuts should be anticipated.

A strong earthquake can also dislodge some of the large residual boulders common on hillsides in San Diego County. There is some risk from these boulders rolling into homes further down the hillsides.

POLICIES ON LIQUEFACTION AND OTHER TYPES OF SOIL FAILURE

It is the Policy of the County of San Diego to:

Identify areas which have the potential for liquefaction, settlement, or other types of ground failure during a major earthquake.

Action Programs:

1. Maintain geologic maps, boring logs, and test data for areas which may be subject to liquefaction or settlement.

2. Prohibit new construction of essential, dependent care, and high occupancy facilities in areas subject to liquefaction or settlement unless measures are incorporated into the foundation preparation and structural design which will make the facilities safe.

8. **TSUNAMIS AND SEICHES**

The State of California requires that each local jurisdiction address the problem of tsunami and seiches in its safety element. Tsunamis or "tidal waves" are large waves generated by earthquakes under the sea floor. Since the coastline of San Diego is now entirely within incorporated cites or under state or federal jurisdiction, the County's role consists only of coordinating disaster response. The cities of Coronado and Imperial Beach and the beach communities in the City of San Diego are potentially subject to major damage from tsunamis.

Seiches are the surging of liquids within confined bodies of liquid such as reservoirs or tanks. They can be caused by ground shaking or by the sudden movement of a landslide into a reservoir. Such events may cause shoreline inundation, overlapping of dams, and possibly some downstream flooding.

A common type of structural failure during earthquakes is damage to water or fuel tanks caused by sloshing of liquid in the tanks. In San Diego County large water tanks are commonly located on hill tops near the subdivision which they serve. Failure of any of these tanks could cause some local property damage and possibly loss of life. Failure of a fuel tank would be more serious because the stream of released fuel could easily ignite. However, fuel tanks are usually surrounded by an earth berm large enough to contain a 100 percent spill from a fuel tank as a security precaution.

POLICIES ON SEICHES

It is the Policy of the County of San Diego to:

1. Identify areas adjacent to reservoirs potentially subject to seiches and tanks potentially subject to damage in an earthquake.

2. Control development in areas subject to damage from seiches or ruptured tanks. Ensure that tanks are designed and constructed to prevent serious rupture.

9. **INUNDATION CAUSED BY DAM FAILURE**

Failure of a major dam during an earthquake could cause serious loss of life, property damage, and panic. Although such an event is very unlikely it is not impossible. Therefore, the State of California requires not only that large dams be inspected for safety, but that plans be prepared to deal with possible failure.

In California the supervision, regulation, and inspection of all large dams that are not federally owned is the responsibility of the Division of Safety of Dams. They conduct periodic inspections of dams and if any deficiencies are found, the owner of the dam is required to take remedial action.

In the 1971 San Fernando earthquake the lower Van Norman Dam (a hydraulic fill dam) partially failed, necessitating the emergency evacuation of over 80,000 downstream residents. As a result the Division of Safety of Dams reevaluated the stability of similar dams under its jurisdiction. They required remedial measures on two hydraulic fill dams in San Diego County. The Vista Irrigation District has constructed additional embankment and spilling downstream from the Henshaw Dam to prevent failure. The City of San Diego is required to maintain the water level in El Capitan Reservoir 30 feet below the spillway of the dam.

Although it is unlikely that any of the dams would fail during an earthquake, the State Office of Emergency Services presently requires dam owners to prepare dam failure inundation maps and submit them to the local jurisdiction for use in land use planning and for the preparation of disaster plans and evacuation procedures.

The County Office of Disaster Preparedness prepared a "General Dam Evacuation Plan for San Diego County" in 1979, and intends to update their document in the near future. There is a separate plan for each dam showing area inundated, inhabited areas and facilities affected, responsible parties, command posts, evacuation routes, specific actions to be taken, etc.

There are approximately 26 major dams in San Diego County. Of these, 23 would, in the event of failure, affect downstream areas within the unincorporated portions of San Diego County. The Office of Disaster Preparedness has the responsibility of coordinating disaster response for all of the major dams. The Department of Planning and Land Use (and the Department of Public Works) have responsibility for land use decisions and facilities planning below the 23 dams above unincorporated areas. Those dams which, in the unlikely event of failure, would inundate unincorporated areas are listed in Table 2.

The area which would be most severely affected in the event of a dam failure are those which are directly below the dams. If the dam failure were sudden, there would be no warning time before a wall of water destroyed everything in its path. Further downstream, not only would there be some warning time, but the water would have spread out and would resemble a normal flood.

The County has no record of the design assumptions used in delineating the inundation areas. Apparently the maps were prepared under contract in the 1970s using very approximate methods. It was assumed that the reservoirs were full and that instantaneous failure occurred. This is a worst case scenario. Not only is the probability of seismically induced failure very low, but the probability of a major earthquake when the reservoirs were full is lower still. Furthermore, most dams would not fail instantaneously.

In most cases the flood wave would first pass down a canyon then spread out over a wide river valley further downstream. There would be some warning time and considerable reduction in the water depth before the flood reached population centers. The main areas of current development which would be affected are Lakeside, Moreno Valley, Santee (San Diego River) and Whispering Palms (San Dieguito Valley). The worst case would be failure of Chet Harritt Dam because there a high flood wave would reach Lakeside with very little warning time. However, Chet Harritt is a modern dam constructed to a design which takes into account seismic forces.

The State only monitors dams higher than 25 feet holding more than 15 acre-feet of water, or dams over 6 feet high with a capacity of 50 acre-feet. In 1978, the County's Department of Sanitation and Flood Control estimated that there were 3,000 earthen dams in the County too small to be inspected by the State.

If a major earthquake occurred when these dams were full, it is reasonable to expect some to fail, causing localized damage. Failure of some of these smaller dams is much more likely during storms than during an earthquake because large storms are more frequent than major earthquakes. The County has no program to inspect or require remedial action on these small dams.

MAJOR DAMS IN SAN DIEGO COUNTY WHICH WOULD
AFFECT UNINCORPORATED AREA IN THE EVENT OF FAILURE

DAM	TYPE OF DAM CAPACITY (ACRE-FEET) CONSTRUCTION DATE	INUNDATION AREA	AFFECTED DEVELOPMENT AND FACILITIES	SAFETY MEASURES
BARRETT	CONCRETE GRAVITY 44,860 1922	COTTONWOOD CREEK	HIGHWAY 94	REANALYZED (1988) AND FOUND CAPABLE TO RESIST SEISMIC DAMAGE
CHET HARRITT (LAKE JENNINGS)	EARTH 10,700 1962	FULL WIDTH OF SAN DIEGO RIVER FLOODPLAIN	DOWNTOWN LAKESIDE; SANTEE: PRISONS, EDGEMOOR & SOME RESIDENCES	CONSTRUCTED BY MODERN PROCEDURES TO RESIST SEISMIC DAMAGE
CUYAMACA	EARTH 11,700 1887	BOULDER CREEK, SAN DIEGO RIVER, EL CAPITAN RESERVOIR	CAMP WOLAHI	REANALYZED (1980) AND RESTRICTED STORAGE LEVEL BY 4-FT. TO ENSURE SAFETY IN EVENT OF SEISMIC INDUCED SLUMPING
EL CAPITAN	HYDRAULIC FILL 116,450 1934	FULL WIDTH OF SAN DIEGO RIVER FLOODPLAIN, MORENO VALLEY	DOWNTOWN LAKESIDE; SANTEE: EDGEMOOR, PRISONS, HWY 67, LOW-LYING RESIDENCES	WATER LEVEL REQUIRED TO BE 30 FEET BELOW SPILLWAY
HENSHAW	HYDRAULIC FILL 203,580 1923	FULL WIDTH OF SAN LUIS REY FLOODPLAIN	PORTIONS OF BONSALL AND OCEANSIDE	RECENTLY STRENGTHENED

LOVELAND	CONCRETE ARCH 27,700 1945	FULL WIDTH OF SWEETWATER RIVER FLOODPLAIN	SWEETWATER DAM	STUDIES (1981) FOUND DAM CAPABLE TO RESIST SEISMIC DAMAGE
LOWER OTAY (SAVAGE DAM)	CONCRETE GRAVITY 56,300 1919	FULL WIDTH OF OTAY RIVER FLOODPLAIN		STUDIES (1979) FOUND DAM CAPABLE TO RESIST SEISMIC DAMAGE

MAJOR DAMS IN SAN DIEGO COUNTY WHICH WOULD
AFFECT UNINCORPORATED AREA IN THE EVENT OF FAILURE

DAM	TYPE OF DAM CAPACITY (ACRE-FEET) CONSTRUCTION DATE	INUNDATION AREA	AFFECTED DEVELOPMENT AND FACILITIES	SAFETY MEASURES
MORENO	ROCK 50,200 1895	COTTONWOOD CREEK	BARRETT AND RODRIQUEZ DAMS, HIGHWAY 94	STUDIES (1981) FOUND DAM CAPABLE TO RESIST SEISMIC DAMAGE
PALO VERDE	EARTH FILL 730 1970	CANYON OF SWEETWATER RIVER BETWEEN PALO VERDE LAKE AND LOVELAND RESERVOIR	JAPATUL ROAD	CONSTRUCTED BY MODERN PROCEDURES TO RESIST SEISMIC DAMAGE
SAN DIEGUITO	MULTIPLE ARCH 1,130 1918	RANCHO SANTA FE GOLF COURSE	LOCAL STREETS, RECREATIONAL AREA IN RANCHO SANTA FE	STUDIES (1982) FOUND DAM CAPABLE TO RESIST SEISMIC DAMAGE

SAN MARCOS #854	EARTH 320 1958	DRAINAGE AREA OF SAN MARCOS CREEK ABOVE LAKE SAN MARCOS	LOCAL STREETS AROUND LAKE SAN MARCOS	CONSTRUCTED BY MODERN PROCEDURES TO RESIST SEISMIC DAMAGE
SAN VICENTE	CONCRETE GRAVITY 90,200 1943	MORENO VALLEY, SAN DIEGO RIVER VALLEY	MORENO VALLEY, NORTHERN LAKESIDE, SANTEE: EDGEMOOR, PRISONS, LOW-LYING RESIDENCES, HWY 67	STUDIES (1981) FOUND DAM CAPABLE TO RESIST SEISMIC DAMAGE
SUTHERLAND	MULTIPLE ARCH 29,000 1954	CANYON OF SANTA YSABEL CREEK, SAN PASQUEL VALLEY, SAN DIEGUITO FLOODPLAIN	SAN PASQUAL VALLEY ROAD, WHISPERING PALMS, SURF & TURF TRAILER PARK, DEL MAR RACE TRACK	1952 STRENGTHENING

MAJOR DAMS IN SAN DIEGO COUNTY WHICH WOULD
AFFECT UNINCORPORATED AREA IN THE EVENT OF FAILURE

DAM	TYPE OF DAM CAPACITY (ACRE-FEET) CONSTRUCTION DATE	INUNDATION AREA	AFFECTED DEVELOPMENT AND FACILITIES	SAFETY MEASURES
TURNER	EARTH 2,000 1971	MOOSA CANYON, CIRCLE R GOLF COURSE,SAN LUIS REY GOLF COURSE	ARTISAN LAKES CAMPGROUND	CONSTRUCTED BY MODERN PROCEDURES TO RESIST SEISMIC DAMAGE
WOHLFORD	HYDRAULIC FILL 7,500 1924	ESCONDIDO CREEK	LAKE WOHLFORD ROAD, OLIVENHAIN, ENCINITAS BLVD., MANCHESTER AVENUE	STUDIES (1983) FOUND DAM CAPABLE TO RESIST SEISMIC DAMAGE
HODGES	MULTIPLE ARCH 33,550 1918	FULL WIDTH OF SAN DIEGUITO RIVER FLOODPLAIN	DEL DIOS HIGHWAY, WHISPERING PALMS, COMMERCIAL DEVELOPMENT ALONG EL APAJO	STRENGTHENED IN 1935
RED MOUNTAIN	EARTH 146 1985	LIVE OAK CANYON	LIVE OAK PARK ROAD (FALLBROOK)	CONSTRUCTED BY MODERN PROCEDURES TO RESIST SEISMIC DAMAGE
SAN MARCOS #848	VARIABLE ARCH 480 1946	SAN MARCOS CREEK	RANCHO SANTA FE ROAD, LA COSTA COUNTRY CLUB GOLF COURSE	LOW STATIC STRESSES NO DYNAMIC ANALYSIS

SWEETWATER	CONCRETE GRAVITY 27,689 1888	FULL WIDTH OF SWEETWATER RIVER FLOODPLAIN	PORTIONS OF BONITA, NATIONAL CITY, AND CHULA VISTA, BONITA ROAD, SWEETWATER ROAD, I-5	STUDIES (1981) FOUND DAM CAPABLE TO RESIST SEISMIC DAMAGE

MAJOR DAMS IN SAN DIEGO COUNTY WHICH WOULD
AFFECT UNINCORPORATED AREA IN THE EVENT OF FAILURE

DAM	TYPE OF DAM CAPACITY (ACRE-FEET) CONSTRUCTION DATE	INUNDATION AREA	AFFECTED DEVELOPMENT AND FACILITIES	SAFETY MEASURES
VAIL (IN RIVERSIDE COUNTY)	VARIABLE RADIUS ARCH EARTH DAM 51,000 1849	SANTA MARGARITA RIVER CANYON	DELUZ ROAD, PORTIONS OF CAMP PENDLETON	STUDIES (1982) FOUND DAM CAPABLE TO RESIST SEISMIC DAMAGE
DIXON	EARTH 2,500 1970	ESCONDIDO CREEK	PORTIONS OF OLIVENHAIN	CONSTRUCTED BY MODERN PROCEDURES TO RESIST SEISMIC DAMAGE
UPPER OTAY	CONCRETE ARCH 810 1901	LOWER OTAY RESERVOIR	OTAY LAKES ROAD	CAPACITY LOWERED TO 810 ACRE - FT. BY CUTTING NOTCH
RAMONA	EARTH 12,000 1988	GREEN VALLEY LAKE HODGES	OLD COACH ROAD HIGHLAND VALLEY RD.	CONSTRUCTED BY MODERN PROCEDURES TO RESIST SEISMIC DAMAGE
MIRAMAR	EARTH 7,250 1960	CARROLL CANYON, SORRENTO VALLEY	MIRAMAR COLLEGE, HIGHWAY 15	CONSTRUCTED BY MODERN PROCEDURES TO RESIST SEISMIC DAMAGE
MURRAY	MULTIPLE ARCH	ALVARADO CANYON,	ALVARADO HOSPITAL,	STRENGTHENED IN

	6,085 1918	MISSION VALLEY	HIGHWAY 8	1970 BY POURING CONCRETE BETWEEN ALTERNATE ARCHES
POWAY	EARTH 4,200 1971	CANYON BELOW DAM AND LAKE HODGES	OLD COACH ROAD, HIGHLAND VALLEY ROAD	CONSTRUCTED BY MODERN PROCEDURES TO RESIST SEISMIC DAMAGE

POLICIES ON INUNDATION CAUSED BY DAM FAILURE

It is the Policy of the County of San Diego to:

1. Maintain a warning system to protect downstream residents who would be affected in the event of flooding due to dam failure.

Action Program:

1.1 Develop a warning system not dependent upon telephone lines to ensure adequate warning for evacuation of residents.

2. Consider zoning regulations to restrict development in high hazard areas below dams where failure could result in immediate loss of life and property.

Action Program:

2.1 Rezone land subject to inundation by dam failure to (24) Impact Sensitive.

3. If feasible, relocate or strengthen structures which would be affected by inundation due to dam failure. Priority is to be given to essential, dependent care, and high occupancy facilities.

4. Maintain an inventory of small dams not under State jurisdictions and or large water tanks. Ensure that the design of future development minimizes risk where failure of such structures would endanger life or structures.

10. **NEW DEVELOPMENT**

The most effective and efficient way to protect the public from the danger of earthquakes is to make sure that all new buildings are built correctly and that they are not built in hazardous areas. There are two basic approaches to increasing the safety of buildings and other structures. The first is to require that all buildings are designed and built utilizing the latest design techniques to ensure against failure during a major earthquake. The second approach is to control the intensity and type of development relative to the severity of the geologic hazards in the area.

BUILDING STANDARDS

All structures currently built in the unincorporated area of the County are required to be designed and built according to the latest version of the Uniform Building Code (UBC). Most one and two story residences are designed to meet the conventional wood framing provisions of the UBC. Other buildings, including homes of unusual design, must be designed by a registered architect or engineer. UBC seismic requirements are minimum life safety provisions intended to safequard against major failures and loss of life, not to limit damage, maintain functions or provide easy repair.

Because major earthquakes are so infrequent it is not generally cost effective to construct buildings and other structures so strong that they suffer no damage, and experience in recent earthquakes in California indicates that modern residential dwellings hold up well. There are however, several design details that should be incorporated into new residential construction such as:

- Bracing at corners of garage door opening below a second story;
- Secure water heaters to walls;
- Sway bracing under mobilehomes;

Those facilities, which are essential for emergency response must be constructed with safety against earthquakes as one of the primary considerations in their design. Not only must the building function, but all of the equipment and supplies inside such as telephones, radios, and computers, must be operable immediately after an earthquake.

LOCATION

The intensity and type of development should be related to the severity of geologic hazards. In general, the highest population density and the most important emergency facilities should be located in areas of lowest geological hazards. At the other extreme, no dwellings or essential facilities should be built right on an active fault. Some "lifeline" facilities such as roads, and gas, water, and electric lines have to cross hazardous areas, and where this is absolutely necessary, the lifeline should be specially designed to either ensure against rupture, or be designed so quick repairs are possible. The intensity and type of development is largely controlled by zoning. The most hazardous area, such as active landslides, very steep slopes, active fault traces, and the areas immediately downstream from dams should be designated as open space.

Areas in which geologic hazards are suspected should be placed in geologic hazard zones such as the Alquist-Priolo Special Studies Zones along active faults. In geologic hazard zones the County can require anyone proposing development to submit a report by a certified engineering geologist so the project can be designed in such a way to ensure the safety of future residents.

Geotechnical studies and special design review should be required for all essential facilities, buildings with high occupancy, and structures with unique design. Ultimately the County should prepare "microzonation" maps showing the types of foundation conditions for the entire unincorporated area. These would be a valuable tool in assessing the risks in specific areas, predicting soil dynamics during earthquakes, and deciding what types of buildings are safest in each area.

POLICIES ON NEW DEVELOPMENT

It is the Policy of the County of San Diego to:

1. Require all buildings to meet the standards of the Uniform Building Code.

2. Continue to require buildings of unusual design or unusual materials (those that do not comply with the Code requirements for conventional construction) to be designed by a registered civil engineer or architect.

3. Continue to require that all buildings and structures to be occupied by large numbers of people be designed so that people can safely escape even if the structure is seriously damaged by an earthquake.

4. Require buildings and structures necessary for emergency response to be designed in such a manner that they can continue to operate efficiently immediately after a major earthquake.

5. Prohibit construction of homes and essential facilities in hazardous areas unless they can be designed to reduce the hazard to the satisfaction of responsible agencies.

6. Require major utility lines which cross hazardous areas to be built with features that provide for either automatic shut-off or for quick repairs.

7. Require submission of soils and geologic reports prepared by a certified engineering geologist on all projects where geologic hazards are known or suspected to be present.

11. POTENTIALLY HAZARDOUS STRUCTURES

Most of the deaths, injuries, and property damage during an earthquake are due to the collapse or partial collapse of buildings and falling parapets. In countries with large numbers of unreinforced masonry buildings and newer, but poorly constructed buildings a major earthquake can be expected to cause thousands of deaths. In San Diego, where most of the buildings are relatively new and well constructed, the damage would be much less severe. However, response teams from San Diego County are likely to be involved in search and rescue efforts in numerous collapsed buildings in Tijuana and other Baja California towns.

Recent experience in California earthquakes (San Fernando, Coalinga, Whittier, Loma Prieta) allows us to make the following broad generalizations about the performance of various classes of buildings during major earthquakes.

- Ductile steel and ductile reinforced concrete frame buildings - highly resistant to structural damage; may suffer some structural and nonstructural damage.

- Vertical load-carrying steel and reinforced concrete frame buildings which use bracing members or shear walls to resist lateral forces - perform well but may suffer some structural as well as nonstructural damage.

- Pre-engineered and other light steel and sheet metal buildings - usually perform extremely well.

- Unreinforced masonry buildings of all types - highly vulnerable to damage and collapse.

- Reinforced brick and concrete block masonry buildings - perform well but may suffer some structural as well as nonstructural damage.

- Newer residential buildings of wood frame construction with wood or stucco siding usually behave well but may suffer damage.

- Modern design open-type houses with large glass openings, split-level houses, and two-story houses or apartments with large garage openings in the first story are vulnerable to earthquake damage.

- Older residential buildings constructed before the 1940s often perform poorly and suffer structural damage.

- Mobilehomes - rarely cause loss of life but may be severely damaged by being knocked off their foundations unless adequately attached and restrained by their supports.

RESIDENTIAL BUILDINGS

Occupants of wood frame residential dwellings are relatively safe from personal injury during an earthquake, but the houses and apartments may sustain some damage. In the conventional wood frame dwelling in Southern California the light weight and the bracing provided by interior and exterior walls combine to provide an adequate system. Some older residences with crawl spaces have inadequate bracing provided by the exterior cripple walls enclosing the crawl spaces.

However, modern open-type houses with large glass openings, split-level houses, and multi-story houses or apartments with large garage openings in the first story are vulnerable to earthquake damage. There is no State or County requirement that such structures be inspected or strengthened. Houses built in the unincorporated area since 1954 have had to meet higher standards of seismic design in order to obtain a building permit. Homeowners who are concerned about the safety of these buildings may, at their own initiative, add reinforcement, shear walls, etc. to increase the strength of their homes.

MOBILEHOMES

Earthquakes rarely cause loss of life in mobilehomes, but the homes themselves may be severely damaged by being knocked off their foundations. Gas or electric lines may be damaged, potentially causing fires or explosions. This problem is solvable in either of two ways. The mobile homes may be attached to permanent foundations or shock absorbers or braces (which are commercially available) can be mounted under the mobilehomes. Neither of these solutions is required by State or County regulations, largely because of the cost involved. A large percentage of mobilehome residents are on limited budgets and are unable to spend the moderate amounts of money needed to provide increased protection.

UNREINFORCED MASONRY BUILDINGS

In California the most common type of buildings which are clearly unsafe during an earthquake are unreinforced masonry bearing wall buildings. The Unreinforced Masonry law passed by the State Legislature in 1986 calls for an inventory and subsequent mitigation plan of all potentially hazardous pre-1946 unreinforced masonry buildings. Excepted from the legislation are most warehouses or similar structures not used for human habitation. Also excluded are those buildings having five living units or less. This law applies only to those jurisdictions located in seismic Zone 4. Most of the unincorporated portion of San Diego County is in Zone 4. The southwestern corner of the unincorporated area from La Cresta and Dehesa and out Highway 94 nearly to Campo is in Zone 3. However, the County is currently (1990/91) pursuing rezonation to Zone 4 throughout the County.

Jurisdictions in Zone 3 may voluntarily inventory their old reinforced masonry structures and come up with a mitigation plan. The City of San Diego, which has the largest number of such buildings, has made an inventory and identified over 800 unreinforced masonry and concrete frame with masonry infill buildings, but have not yet prepared a report on action to be taken.

The County of San Diego has completed an inventory of unreinforced masonry buildings in the unincorporated area. Only a limited number of unreinforced masonry buildings were located; mostly in the central parts of Country Towns such as Fallbrook, Ramona and Lakeside.

The Office of Planning and Research General Plan Guidelines recommend that the unsafe buildings inventoried be evaluated and priorities established for abatement of existing structural hazards. They further recommend that geologic hazard abatement districts be formed for the purpose of reducing the hazards (Public Resources Code, Sections 26500 et. seq.). The Unreinforced Masonry Law requires that the County establish a mitigation program and notify building owners that their structures are potentially hazardous in earthquakes. (This is a requirement in Seismic Zone 4 only.)

Any program which requires owners of substandard buildings to strengthen their buildings will be very controversial because of the large expense involved. Often the structurally unsound buildings are located in the older portions of town and are of marginal economic value.

The City of Long Beach has had an earthquake hazard abatement program since 1959. With considerable effort they have been able to achieve demolition or strengthening of 332 out of about 1,000 unsafe buildings. The City of Los Angeles has adopted a mandatory plan for strengthening unreinforced masonry buildings and 17 percent of the buildings with unreinforced masonry load-bearing walls have been demolished or vacated, 35% are in full compliance. Most of the rest are being reinforced or have submitted plans.

The three basic approaches to increasing building safety are:

- Demolition and replacement.

- Reducing risk by lowering the occupancy level.

- Strengthening the structure.

There are a variety of construction techniques short of full structural strengthening which provide additional safety. These include the addition of shear walls, placement of roof and floor diaphragm anchors, infills of store fronts with concrete block, and parapet bracing. Some older buildings should be retained for their historical value. Usually additional safety can be achieved without radically altering the appearance of the building. There are available, to those who restore historical structures, tax incentives, which enable their owners to recover some of the money spent on strengthening their buildings.

OTHER TYPES OF BUILDINGS WHICH MAY BE UNSAFE

In addition to unreinforced masonry buildings there are other structures constructed using materials or methods that have poor records of performance during earthquakes. Other designs and materials are so new that they have not been adequately tested by a major earthquake. There are also some buildings constructed with code violations.

RIGID CONCRETE STRUCTURES WITH MASONRY INFILLING

These are buildings which are constructed with reinforced concrete posts and beams with the wall spaces filled in with unreinforced masonry. There are a few examples of these in downtown San Diego and one in Fallbrook. There is ample evidence from earthquakes in other countries that these kind of buildings perform very poorly.

SOFT STORIES

"Soft Story" buildings are those in which at least one story--often the ground floor--has significantly less stiffness than the rest of the structure. In a major earthquake this weak link can fail, leading to partial or total collapse of the rest of the building. The collapse of the psychiatric building and the near collapse of the main building of the Olive View Hospital in the 1971 San Fernando earthquake are examples. Both were newly constructed.

Typically soft story buildings have walls and other bracing in the upper stories placed on columns, but leave the first story open for parking, landscaping, and other purposes. Buildings with soft stories should be identified and strengthened. Identification may be difficult if columns in the first story are hidden by cladding. Existing soft stories can be effectively braced with reinforced concrete shear walls or steel braces. New buildings can include open areas if they include special design measures to give them adequate strength.

REINFORCED CONCRETE BUILDINGS

Reinforced concrete is commonly used for construction of commercial and industrial buildings as well as taller apartment buildings. Reinforced concrete is relatively inexpensive, fire resistant, and under normal conditions very strong. The reinforcing steel and the concrete, when combined, form a single structural material that takes advantage of the compressive strength of concrete and the ability of steel to retain its strength under tension or bending.

Under severe earthquake bending, steel and wooden buildings are usually flexible enough to bend with the shaking motions but return to their original shape without structural damage.

Reinforced concrete buildings on the other hand, may be severely damaged in a strong earthquake unless they are properly designed and properly constructed. The problem is caused by the concrete which is very strong under compression but weak when subject to tension and shear forces. During an earthquake, the inertia of the considerable weight or mass of a concrete building causes it to tend to remain stationary while the earth to which the building is attached is vibrating back and forth. This causes stress throughout the building.

Some of the stress (ideally all of the stress) is dissipated as the energy is used up in shaking the building. The remainder of the energy is concentrated on the weakest points in the structure which may fail--either partially or completely. An asymmetric shaped building may concentrate an inordinate amount of destructive energy in critical part or parts of the building. More commonly, the stress is concentrated at the connections between walls or pillars and the floors that they support.

In most buildings it is not desirable from an economic point of view to design the connections between floors and roofs and their vertical supports so that they will come through a major earthquake without damage. What is important is that the connections not fail completely causing collapse of the building on the occupants.

Modern design practice for reinforced concrete buildings increasingly is toward designs which allow buildings to move in such a way that the energy is dissipated without causing serious damage. There is a large amount of ongoing research on structural engineering design to make buildings safer during earthquakes. There is also an ongoing effort to modify building codes based on the information obtained from research and from examination of buildings which have been subject to severe earthquakes.

TILT-UP CONCRETE BUILDINGS

Since the 1960s this type of construction has become very poplar for commercial and industrial buildings because it is fast and relatively inexpensive. Many older tilt-up buildings have performed poorly during large earthquakes. Those constructed since the mid 1970s have been constructed to higher standards.

BUILDINGS WITH UNUSUAL CONFIGURATIONS

In a normal, rectangular building constructed of one type of material it is relatively easy to predict the way the structure will react during an earthquake, based either on experience or on engineering analysis. However, in buildings with irregular shapes, or combinations of materials or untested materials, it is much more difficult to predict the way in which seismic stresses will be transmitted from the ground up through the structure. In a building with a unique design, vibratory forces may be concentrated on some structural parts of the building which if not designed for these specific force concentrations may be unable to withstand those forces, and failure will result. Any building of unusual design requires more extensive (and expensive) design effort in order to ensure safety.

NON-STRUCTURAL DAMAGE

In addition to structural damage to buildings, there is always, in a major earthquake, considerable damage related to utility lines and the contents of buildings. The most serious concern is fire. When gas lines break, fire or asphyxiation is a definite possibility. During a major disaster the fire department and utility companies will not be able to respond to most of the calls - assuming that calls can even be made. In commercial and industrial buildings, or multi-family residences there should be automatic shut-off devices. Such devices are also available to individuals, and some jurisdictions require automatic shut-off devices for new single family developments.

Commercial, industrial, and larger multi-family buildings often contain extensive support system - heating, ventilation, air conditioning, and electrical. Heavy equipment, such as transformers, need to be adequately secured. Pipes and conduit need enough flexibility to handle some movement without breaking.

Another common problem is damage to, or damage and injury from building contents. In houses, water heaters and other heavy objects should be securely fastened to the walls, and heavy objects should not be located over beds or other places where they could injure someone.

In the higher floors of office buildings, heavy furniture such as desks and filing cabinets should be bolted to the walls or floors so that they do not careen across the rooms. Loose items such as groceries, liquor, books, and medicine may be thrown to the floor. Relatively simple restraining devices can prevent the considerable economic loss from damaged goods. Precautions are even more important where loss or mixing of essential inventory as in a pharmacy, would prevent a critical business from functioning effectively.

Damage to contents is even more serious in any establishment that handles hazardous chemicals, including fuels. Every business that deals with hazardous and toxic materials must have a fail safe plan for preventing spills and containing and/or neutralizing released material. Additionally,there should be an operation plan for dealing with earthquakes, and regular earthquake drills.

POLICIES ON UNSAFE STRUCTURES

It is the Policy of the County of San Diego to:

1. Prepare and maintain an inventory of structures which would likely be seriously damaged during a major earthquake.

Action Program:

Inventory the following potentially hazardous buildings and establish priorities for their safe management, rehabilitation, and/or replacement.

1.1 Unreinforced masonry (URM) buildings, including those with URM wall infilling;

1.2 Pre-1947 nonductile concrete frame buildings;

1.3 Post-1947 to pre-1973 nonductile concrete frame buildings;

1.4 Inadequately designed pre-cast tilt-up constructions;

1.5 Multistory buildings with soft stories;

1.6 Inadequately designed structures with geometrical irregularities including long spans, irregular shapes, etc.;

1.7 Mobile homes and buildings not properly secured to their foundations;

1.8 Dilapidated buildings;

1.9 Buildings with interior and exterior nonstructural hazards.

1.10 Unreinforced masonry parapets and chimneys.

2. Reduce the risk from collapse of unsafe buildings by requiring that the owners strengthen, remove, or lower the occupancy of such buildings.

3. Encourage the preservation of historical and unique buildings, while at the same time requiring the building owners to take measures to reduce the risk from collapse.

4. Inform the owners of mobile and manufactured homes of suggested methods to reduce the vulnerability of such structures, such as attaching them to permanent foundations or by the use of earthquake bracing.

5. Reduce nonstructural hazards

Action Program

5.1 Modify County building codes to require increased bracing of nonstructural components and contents of buildings.

12. **ESSENTIAL FACILITIES**

Essential facilities are those facilities and parts of a community's infrastructure that must remain operational or can be restored quickly after an earthquake for a community to respond effectively. Categories of essential structures include those:

- o Needed after a disaster for emergency response:
  Emergency communications, hospitals, fire stations, police stations, emergency operation centers, ambulance services;
- o Whose failure might be catastrophic, such as large dams or nuclear power plants;
- o Utilities whose continuing function is critical, such as roads, bridges, and overpasses, major electrical power plants and major power lines, water lines, sewer lines, and major fuel lines;

STRUCTURES NECESSARY FOR EMERGENCY RESPONSE

Those essential structures which are necessary for emergency response must not only survive a major earthquake, but must be able to function at full efficiency. Essential facilities should be located, designed, and constructed in such a manner that they can continue to function after a major earthquake. Designing a building to this higher standard entails not only a stronger structure, but also greater attention to non-structural items such as elevators, lighting, and storage facilities.

For essential structures the design of buildings must include whatever added cost is necessary to assure the continued functioning and safety of the structures. Such structures should never be located on a site of high seismic hazard. Those existing essential facilities which are identified as being potentially non-operable after an earthquake must be strengthened and their equipment secured so they will function after an earthquake. Sensitive equipment, such as main-frame computers, may have to be isolated from buildings so that it will not shake with the building.

EMERGENCY COMMUNICATIONS

During a disaster it is absolutely essential that an emergency communications system continue to function. The emergency operations center must be able to rapidly determine where the most serious problems are and quickly dispatch response teams for rescue, fire fighting, medical care, etc.

The San Diego County Emergency plan relies on a variety of communication systems. Ideally, the land based telephone system would be working. However, immediately following a major earthquake telephone systems have a tendency to become so overloaded that they begin to shut down. Even if there has been no damage to the system itself, the telephones may not be usable for some period of time immediately following the event.

Recognizing these possibilities, the County has taken some steps which will mitigate some of the communications difficulties.

1. Equipment at major radio sites is being seismically braced to increase the chances of operation survivability in the event of a major earthquake. Approximately one-third of the sites have been braced.

2. The County has installed a microwave hotline system which interconnects with both Sancontel and Pac Bell. However, a few links are on leased land lines.

3. The Public Safety microwave system has been designed with redundancy so that loss of a single major path does not result in catastrophic system failure.

The Office of Disaster Preparedness also has access to a satellite, both from the Emergency Operations Center and at the alternate Emergency Operations Center.

Another system which can be used is the Life Saving Information for Emergencies (L.I.F.E.) system. This system consists of receivers that have been installed at most schools, hospitals, and radio and TV stations. These receivers can be activated either by radio or telephone to broadcast essential information to critical facilities, and the media. It could be used to notify public employees for example, to report to their work stations by requesting the media to broadcast a message to that effect.

The Emergency Broadcast System is another means of advising and warning the public and the media of actions to be taken which will help to save lives and property. The Emergency Broadcast System is not microwave or land line dependent, and gives the Office of Disaster Preparedness the ability to broadcast directly from the Emergency Operations Center to the public.

HOSPITALS

In a really major disaster all of the hospitals in the region will have to operate at maximum capacity. Any damage which would seriously impair the ability of even one hospital to function effectively is not acceptable. Serious damage to equipment and supplies can impair medical response to an emergency. All back-up equipment such as electrical generators, fuel and water supplies, etc. must be securely fastened and in positions where they will not be damaged. Several days supply of food, water, medicines and other supplies must be on hand. These supplies have to be stored in such a manner that they are not damaged or thrown into disarray.

The safety of hospitals is a responsibility of the State of California. Hospitals built before 1972 may not meet the seismic standards of the Hospital Act. Each hospital in the region does have an emergency operations plan and conducts regular drills.

EMERGENCY RESPONSE FACILITIES

Fire stations, police stations, ambulance services, and emergency operation centers must have the ability to provide immediate response during an earthquake or other disaster. This means that they must be staffed at all times and have a means of automatically calling up reserve personnel in an emergency. In the event of a break in communications during a major earthquake, the earthquake itself serves as a call-up signal to off duty personnel.

Each emergency response center must be staffed with emergency supplies of food, water, and other supplies, and each must have an independent source of power. Both the power equipment and vehicles, such as fire trucks and ambulances, must be kept where they will not themselves be damaged.

CATASTROPHIC FAILURES

Failure of a large dam or nuclear power plant as the result of a major earthquake would make the disaster much worse. Such structures must be designed so that they cannot fail during an earthquake, however large. The safety of dams is discussed in the section "Inundations Caused by Dam Failure."

The San Onofre Nuclear Generating Station is located in the northwestern corner of San Diego County. Because a release of radioactive material could be so devastating, the San Onofre Plant is designed against the maximum credible earthquake and has built in a very large safety factor and numerous automatic shut-off provisions. Nevertheless, an emergency evacuation plan for San Onofre has been prepared. Copies are on file at all of the concerned agencies and an evacuation brochure has been provided for all residents within ten miles of the plant.

TRANSPORTATION

A major earthquake in San Diego would certainly cause serious damage to portions of the transportation network. A number of local streets might be temporarily blocked by collapsed buildings and downed electrical lines. Rockfalls and landslides would block short sections of the highways and some of the bridges and overpasses may collapse. The fills for Highway 5 across the lagoons and the runways of Lindberg Field may be damaged by liquefaction of the underlying soil. On the rail lines some of the rails would be bent out of shape, cuts would be blocked by slumping, and fills distorted by lurching or liquefaction. At least some of the harbor facilities would likely fail because of soil liquefaction, collapse of bulkheads, etcetera.

On the other hand, most of the freeway system should remain intact or repairable in a few days for limited use. The runways at Brown Field and Tijuana International Airport on Otay Mesa would probably be serviceable, although there might well be some damage to the control facilities.

Very quickly after an earthquake the Office of Disaster Preparedness will determine which routes are open or can soon be opened. Within a few days, or even perhaps hours, massive amounts of aid - medical supplies, doctors, rescue workers, food, etc., will be available from the rest of the United States, Canada, and Mexico. The disaster coordinator will have to direct this outside relief so that the appropriate help is directed to where it is most needed, and at a rate which does not disrupt the remaining capacity of the transportation system.

UTILITIES

In a large earthquake there will be damage to the utility (or "lifeline") systems that provide water, sewers, electricity, fuel, and transportation to the community. It is anticipated that entire communities will have their service interrupted for a few days until emergency repairs are made. To a large degree each individual residence, business, and institution will have to survive on its own for the first 72 hours.

Some facilities, such as the aqueducts which carry water from the Colorado River and Northern California, are likely to be broken. During the months that it will take to make repairs, water rationing would be necessary in most of San Diego County.

Many essential facilities, particularly lifelines, are vulnerable to the effects of earthquakes. Landslides and rock falls, for example, can block highways and railways; surface fault ruptures can damage highways, runways, and railbeds or break sewer, water, or fuel pipelines and thereby cause pollution and fire hazards. Strong shaking can cause transmission lines and overpass structures to fail, and power transmission and highway and railway use will be interrupted; liquefaction and the resulting ground failures can cause failure of bulkheads, piers, and quays, thereby disrupting shipping.

If water, sewer, telephone, and electrical systems remain operational, or can be restored quickly, the difficulties of providing an effective emergency response to an earthquake, and of recovery, will be greatly reduced.

Another important aspect of damage to utilities is that their destruction could make a bad situation even worse. The most striking example of this is the 1906 San Francisco Earthquake where, because the fire fighting system was inadequate, far more damage was caused by the ensuing fire than by the earthquake.

To ensure effective, immediate fire fighting capacity the fire stations themselves must be quake-safe and there must be local sources of water available. Also, to the extent possible, major water distribution lines should be strengthened.

Fuel transmission and storage facilities are likely to be damaged and are a potential source of danger from both fire and asphyxiation. Danger points are at the tanks, which may collapse or leak; at the points where lines connect to the tanks; and where the lines cross unconsolidated ground such as the lagoons. The fuel storage tanks at the lower end of Murphy Canyon are surrounded by dikes high enough to contain escaped fuel.

HIGH-OCCUPANCY BUILDINGS

Failure of a single high-occupancy structure can result in hundreds of deaths and injuries. Seismic design is particularly important when the occupancy is involuntary, such as in schools or jails, or when the occupants are in some way disabled, such as in hospitals, nursing homes and mental institutions.

Unlike essential facilities necessary for emergency response, high- occupancy buildings do not have to function after an earthquake. They do not even have to be repairable, but it is very important that they do not collapse completely or catch on fire.

High occupancy buildings should be identified as part of a hazardous building inventory. Potentially hazardous buildings should be individually evaluated by a structural engineer and, if found hazardous, accorded high priority for strengthening under hazardous building abatement programs.

The degree of risk can be reduced by strengthening the buildings, reducing the occupancy, or by razing the buildings. It is important to remember that the goal is not for the buildings to function perfectly in an earthquake, but only that they not collapse on the occupants. It is not economically feasible to construct most buildings to survive without damage in an event so infrequent as a major earthquake.

High occupancy building owners or managers should be required to prepare evacuation plans. Evacuation procedures should be distributed to occupants with additional safety information. Conducting earthquake drills in high occupancy buildings helps to prepare occupants for earthquake response and can be effective in testing emergency preparedness plans. Training programs for building managers, safety directors, building engineers and occupants of high-rise buildings should be developed to meet the emergency demands of a major earthquake.

SURVIVABILITY OF ESSENTIAL FACILITIES

If essential facilities are to function adequately after an earthquake the following steps have to be taken before the earthquake:

- o Identification of essential facilities.
- o Establish standards for performance.
- o Assess vulnerability.
- o Determine what needs to be done to bring each facility up to an acceptable level.
- o Determine responsibility and schedule for remedial action.

The first steps in preparing essential facilities for survival in an earthquake is to identify the facilities. The essential facilities in the San Diego County/Tijuana region are being mapped by the Department of Planning and Land Use.

The second step is to determine the ability of each facility to remain operable after a severe shaking. The vulnerability of each structure needs to be assessed. Usually a structural engineer, and often an engineering geologist or geotechnical engineer is needed. Evaluation of vulnerability includes site hazards, structural design, facility function, and relative importance of each facility.

The next step is to determine what needs to be done to bring each structure to a condition where it can function immediately after an earthquake. In California there has been considerable experience in finding out what fails during an earthquake and there is a large amount of literature that describes how to make existing buildings and structures safe. Some of the more common solutions are:

- o Add ties to secure ceilings to bearing walls;
- o secure heavy equipment to walls and floors;
- o provide redundancy in key equipment;
- o secure supplies so they cannot fall off of shelves;
- o containment for hazardous materials;
- o emergency generating and communications equipment;

- flexible connection between pipes and containers and multiple shut-off valves;

- provide additional lateral reinforcement.

The next step is to develop a schedule and determine responsibility for upgrading the essential facilities. Facilities intended for emergency response and those whose failure would entail a large loss of life should receive the highest priority.

The responsibility for the safety of facilities is fragmented. The Federal Government is responsible for all of the military facilities. The State of California takes care of safety measures for dams, public schools, and hospitals. Each city, and in the unincorporated area, the County is responsible for the safety of private schools, nursing homes, and high occupancy structures.

Each fire district, water district, and the gas and electric company has responsibility for its own facilities. But the County, because of its role in coordinating disaster preparedness and response, has an overall responsibility to try to get all of these jurisdictions and public utilities to make their essential facilities earthquake safe. The mechanism for doing this is not well developed.

The State has established standards in some cases. For example, after the 1971 San Fernando earthquake, the State adopted the Hospital Seismic Safety Act of 1972 (Health and Safety Code Section 15000 et.seq.) establishing design standards for the construction of new hospitals. The Essential Services Buildings Seismic Safety Act of 1986 (Health and Safety Code, Sections 16000-16111) requires that facilities which must provide essential services after an earthquake be designed and constructed to resist earthquake forces.

The State Unreinforced Masonry Law mandates that each jurisdiction have an ordinance on unsafe masonry buildings. The County's recently adopted Unreinforced Masonry Ordinance requires building owners to strengthen substandard unreinforced masonry buildings of certain types. This ordinance applies to Zone 4, but not to Zone 3 (the southwestern corner of the County).

POLICIES ON ESSENTIAL FACILITIES

It is the Policy of the County of San Diego to:

1. Ensure that facilities whose continuing functioning is essential to society, and facilities needed in the event of emergency, are so located and designed that they will continue to function in the event of a disaster.

2. Ensure that structures for involuntary occupancy (such as schools, hospitals, and jails) and

structures for high voluntary occupancy (theaters, churches, offices, apartment houses, etc.) are so located and designed that they will not collapse or burn before the occupants can be evacuated.

3. Require periodic inspection of all essential facilities under County jurisdiction and to urge other jurisdictions to do the same for facilities which are their responsibility.

Action Programs:

3.1 Survey all essential facilities in the region and report the results to the Board of Supervisors. Each essential facility shall be evaluated by a structural engineer, an engineering geologist, and a safety specialist with knowledge of the specific type of facility. The evaluation shall include the structural integrity of the building, the safety of its contents, and its disaster plan.

3.2 Update map of essential facilities and survey of their state of readiness every year.

3.3 Prepare a work program for each essential facility that is found unable to perform adequately during an earthquake.

3.4 Prepare a budget and schedule to be submitted each year until all of the essential facilities are brought up to an acceptable state of readiness.

4. Prohibit construction of essential facilities in any area subject to geologic or other hazards. If there are no feasible alternative sites, these facilities shall be designed to mitigate any seismic hazards associated with their sites.

5. Ensure that access routes to essential facilities and high occupancy buildings remain open after a major earthquake. Such facilities include hospitals, fire stations, heavy equipment yards, communication facilities, and dependent care facilities.

6. Ensure that vulnerable lifeline systems such as fuel lines, water lines, and power lines and stations will either remain in operation or are quickly repairable. Each responsible agency or company should be urged to stockpile parts and equipment which would be necessary for emergency repairs.

13. DISASTER PREPAREDNESS AND RESPONSE

REQUIREMENTS

The California Emergency Services Act enables legal jurisdictions to create disaster councils by ordinance and requires that any such council develop plans for meeting emergencies. In 1961, the Unified San Diego County Emergency Services Organization was established. It consists of the County and all of the Cities within the County and was established by signed agreement. The current agreement is the Third Amended Emergency Services Agreement. This agreement basically provides for "preparing mutual plans for the preservation of life and property and making provision for the execution of these plans in the event of a local emergency, and to provide for mutual assistance in the event of such emergencies." It also calls upon the County to provide such services as Coroner, health, medical, traffic control, public information, radiological safety, and hazardous materials.

The Unified Disaster Council is the policy making body of the Organization and is "empowered to review and approve emergency mutual aid plans and agreements, disaster preparedness plans, and such ordinances, resolutions, rules and regulations as necessary to implement" them. The Office of Disaster Preparedness (ODP) staff serves as staff to the Council and its members.

San Diego is one of only three counties in the state which has adopted the Operational Area Concept. The concept allows the County and all eighteen Cities to speak with one voice to the State or Federal government. This makes it considerably easier to coordinate the delivery of resources to all nineteen entities. The Office of Disaster Preparedness is the focal point for communications with the State and Federal governments.

The Office of Disaster Preparedness (ODP) has many responsibilities which it carries out throughout emergencies and non-emergencies. During a disaster, ODP is responsible for getting information and passing it on the State and Federal governments so that resources can be utilized most appropriately and so that the process of damage assessment can begin. During periods of calm, ODP has the responsibility of training City and County staff in disaster management and writing plans that will act as a guide to Emergency management. ODP also does a lot of public education, training individuals how to take care of themselves and their neighbors during an emergency, and telling them what to expect from their local government.

The Office of Disaster Preparedness has committed to a progressive exercise program which will work with each of the Cities and the County to train their personnel in the management of disasters. This is a scheduled program which was started in 1988, and will continue until all interested cities have gone through the process.

In addition to working on mutual assistance programs within the County, ODP is working on mutual aid plans within the region. Fire and Law Enforcement agreements are already in place, and a Medical Mutual Aid System is near completion.

EMERGENCY PLAN

The San Diego County Emergency Plan is a plan prepared prior-to-need for management of effective response after a disaster. Its objectives are:

- o Provide a system for the effective management of emergency situations.
- o Identify lines of authority and relationships.
- o Assign tasks and responsibilities to County staff.
- o Provide protection and maintenance of County facilities and services.
- o Assure continuity of government.
- o Provide a framework for recovery operations.

The central idea of the disasters management system is that operational control remains with local authorities and is vested in one manager. In a major disaster, the County Administrative Officer assumes authority for directing disaster relief efforts in the unincorporated area and coordinating efforts in the cities.

ASSIGNMENTS

Disaster response functions of County departments generally parallel their normal functions. Those day to day activities which do not contribute directly to the emergency operation may be suspended and personnel reassigned to other emergency tasks. In the Emergency Plan each department's emergency function is described in an "Annex" or operation plan (see table describing annexes). Some functions, such a fire fighting, are already organized and already are functioning under a mutual aid operational plan. Other functions, such as medical care, normally operate as separate entities and require considerable prior planning and practice if they are to work as an integrated unit.

Within the terms of contracts with other jurisdictions, the Office of Disaster Preparedness has County-wide responsibilities for the following tasks.

- o Organization and development of the emergency services program.

- Supply and accounting of emergency services supplies.
- Recruitment and training of emergency services personnel.
- Procuring and inventorying of emergency services equipment.
- Obtaining Federal matching funds and surplus property.
- Development and maintenance of an emergency services communication system.

The California Government Code which mandates the preparation of a Safety Element has a requirement that the element include an "assessment of adequacy of existing emergency preparedness and evacuation plans to deal with identified hazards."

ANNEX	RESPONSIBLE AGENCY	AREAS OF RESPONSIBILITY	SPECIAL PROBLEMS
EMERGENCY MANAGEMENT	CHIEF ADMINISTRATIVE OFFICER	COLLECT AND EVALUATE INFORMATION, COORDINATE EMERGENCY OPERATIONS	
FIRE	SAN DIEGO CITY FIRE DEPARTMENT	FIRE FIGHTING, RESEARCH AND RESCUE, ASSIST MEDICAL RESPONSE AND HAZARDOUS MATERIALS	
LAW ENFORCEMENT AND TRAFFIC CONTROL	SHERIFF	PROVIDE SECURITY, TRAFFIC CONTROL, AND COMMUNICATIONS, ASSIST RESCUE AND MEDICAL EFFORTS	
MEDICAL MULTI-CASUALTY OPERATION	DEPT. OF HEALTH SERVICES	COORDINATE MEDICAL RESPONSE	
PUBLIC HEALTH	DEPT. OF HEALTH SERVICES	PREVENTION OF DISEASE FROM WATER, WASTES, AND FOOD; CONTROL OF HAZARDOUS MATERIALS	
MEDICAL EXAMINER	MEDICAL EXAMINER	RECOVER, IDENTIFY AND DISPOSE OF THE DEAD	
CARE AND SHELTER	RED CROSS AND DEPARTMENT OF SOCIAL	MANAGE RECEPTION AND MASS CASE CENTERS.	

	SERVICES	PROVIDE FIRST AID	
EVACUATION	SHERIFF	ESTABLISH EVACUATION ROUTES AND COORDINATE MOVEMENT OF PEOPLE TO SAFER AREAS	
RESCUE	SAN DIEGO CITY FIRE DEPARTMENT	LOCATE PERSONS IN NEED AND PROVIDE LIFE SAVING MEDICAL CARE	NEED TO DEVELOP TRAINING PROGRAMS FOR LIGHT SEARCH AND RESCUE

ANNEX	RESPONSIBLE AGENCY	AREAS OF RESPONSIBILITY	
CONSTRUCTION AND ENGINEERING	DEPT. OF PUBLIC WORKS	RESTORE ESSENTIAL SERVICES, MAINTAIN AND PROVIDE TRANSPORTATION RESOURCES, ASSIST IN HEAVY RESCUE	
RESOURCES AND SUPPORT	SEVEN COUNTY DEPARTMENTS	PROVIDE MANPOWER, FUNDS, SUPPLIES, FUEL, FOOD, ETC.	
ANIMAL CONTROL	DEPT. OF ANIMAL CONTROL	COLLECT, EVALUATE, AND CARE FOR OR DISPOSE OF ANIMALS	
MENTAL HEALTH	DEPT. OF HEALTH SERVICES	PROVIDE EMERGENCY MENTAL SERVICES AND COUNSELING	NEED FOR IMMEDIATE CRISIS INTERVENTION AND CRISIS DEBRIEFING FOR RESCUE

			WORKERS
PUBLIC INFORMATION	OFFICE OF PUBLICATIONS	PROVIDE INFORMATION TO MEDIA AND CITIZENS	
DAMAGE ASSESSMENT	DEPT. OF PLANNING AND LAND USE/OFFICE OF DISASTER PREPAREDNESS	DETERMINE EXTENT OF DAMAGE AND REPORT TO CAO AND STATE	
ENVIRONMENTAL HEALTH	DEPT. OF HEALTH SERVICES (ENVIRONMENTAL HEALTH)	IDENTIFY AND SOLVE PROBLEMS	
COMMUNICATIONS	DEPT. INFORMATION SERVICES/OFFICE OF DISASTER PREPAREDNESS	IDENTIFY SYSTEMS NEEDS AND REPAIRS	
RADIOLOGICAL	DEPT. OF HEALTH SERVICES/OFFICE OF DISASTER PREPAREDNESS	IDENTIFY AND SOLVE PROBLEMS	

NEED FOR PRIOR PLANNING

No matter how much prior planning for protection is done, no matter how much money is spent on strengthening man-made structures, we cannot prevent disasters. Earthquakes, floods, fires, etcetera, will occur and will cause deaths, injuries, and property damage. The goal is to minimize these negative effects.

It is very easy to delay or relegate to lower priority, the necessary planning and preparation for disaster response. There is always pressure to allocate government resources in time and money to the solution of other problems that are here on a daily basis. Because we do not know specifically what sort or size of disasters will happen or when they will occur, it is easy to think of disasters in terms of "if" they should occur.

It is more realistic to view disasters as something that will happen, and to invest effort in trying to make reasonable, educated guesses about where and, if possible, when they will occur, and make plans for damage control - for ways to reduce the deaths, injuries, and property damage.

Effective response depends upon the willingness and commitment to plan and to spend time and resources on training and testing plans against future emergencies. The failure to make such investments could leave this region in an unacceptably vulnerable condition.

It is imperative that we plan ahead and have plans in place and ready to go when a disaster occurs. We cannot start planning and coordination at the time a disaster occurs. Under the best of circumstances, during a disaster there is confusion, problems of communication, and some equipment that should be ready and is not ready.

Timing is critical in saving lives. Hours and minutes count. In the case of fire, the need for quick response is obvious to everyone. In a major earthquake victims will be trapped inside of collapsed buildings. In addition to having serious injuries they will be subject to fear, shock, and exposure to heat or cold.

In the event of a major earthquake a large amount of (or even too much) outside aid will be brought into the area. However, for the first 72 hours the area may be isolated from this outside aid by collapsed bridges, rock falls on the highways, damaged airfields, etc. Furthermore, individual communities and neighborhoods may be isolated from each other and from sources of local aid. It is therefore important that there be emergency equipment, supplies, and trained personnel available in each community and neighborhood.

Because of the anticipated difficulties in communication and transportation, it is also important that each place of work, school, institution, and home be able to survive independent of outside help for the first hours or even days of a major disaster. Each office, factory, institution and homes should have the following essentials on hand:

- o Flashlight and batteries
- o Portable radio
- o First aid kit
- o Fire extinguishers
- o Food
- o Water
- o Medicines or special foods
- o Tools for turning off of gas and water and
- o A plan for reducing hazards and for getting to a safe place.

Some institutions or families have to consider special problems. A factory that uses hazardous chemicals must have special containment facility and emergency procedures. A family member who needs special medication needs to have a stock of medicine on hand at all times. Every institution such as a prison, rest home, mental institution, etcetera, that has clients needing special care or control must have an established procedure for dealing with an earthquake or fire. Essential facilities such as fire stations and hospitals must not only survive a disaster but must continue to function.

MILITARY INSTALLATIONS

San Diego County has several major defense installations - Camp Pendelton, Miramar Naval Air Station, North Island Naval Air Station, and the Marine Corps Recruit Depot. While neither the County or City have any authority over the military facilities, there would need to be close cooperation with the military authorities in the event of a major disaster.

In a major earthquake the Navy facilities on Point Loma may be damaged by landslides, North Island Air Field damaged by liquefaction, pier facilities damaged, housing units damaged, and military personnel injured. Their national defense mission may require that they give top priority to emergency reconstructions of their own facilities.

However, to the extent that they are able, the Navy and Marine Corps can provide a large resource of trained manpower, emergency equipment, medical services, and food supplies. All of these are maintained in a state of readiness which is not normally associated with the civilian sector. In Baja California, the Mexican Army, Navy, and Air Force would be available for emergency duty.

POLICIES ON DISASTER PREPAREDNESS AND RESPONSE

It is the Policy of the County of San Diego to:

1. Strengthen the capability of County agencies to respond to earthquake and non-earthquake induced emergencies effectively.

2. Designate a Countywide system of community disaster staging and evacuation centers including schools, parks, and other appropriate facilities.

3. Establish mutual aid agreements with other jurisdictions so that in the event of a disaster response local teams can cross County, State and National boundaries without delay.

4. Improve regional urban heavy rescue capability, including mobilization operations and resources management.

5. Promote and support neighborhood and community self-help groups utilizing existing Community Planning Groups, Sponsor Groups, and the Neighborhood Watch Program. Each self-help group should include a permanent core of trained volunteers and a plan for dealing with neighborhood needs for the first 72 hours after a major earthquake or other disaster. The volunteers should be trained in home emergency preparedness, light search and rescue, and short-term medical aid.

6. Develop a training program for County employees, self-help groups, other jurisdictions, schools, and companies. The program shall include first aid, fire fighting, communications, search and rescue, etcetera.

7. Encourage essential facilities to maintain and regularly update emergency response plans identifying safety procedures, disaster control capabilities, and evacuation measures such as drills and exercises.

8. Encourage private employers to develop Private Sector Earthquake Preparedness Plans, update those plans annually, and establish an ongoing education program to reinforce the message of the plan.

9. Maintain an ongoing public information and education program to increase the awareness of seismic risks and ways to be better prepared.

10. Maintain an emergency warning and communications system.

11. Prepare and maintain an inventory of points of vulnerability.

12. Improve the capacity of County-owned facilities to survive and function after a major earthquake.

Action Programs:

12.1 Inventory and analyze all County-owned facilities in a three phase program as follows:

Phase 1. Preliminary structural review.
Phase 2. Perform a structural analysis of each structure.
Phase 3. Prepare construction documents for correction of deficiencies.

12.2 Provide emergency generators for each building that has an essential function. All generators shall be provided with adequate bracing, fuel, spare parts, and a fuel pumping system not dependent upon normal power sources.

12.3 Prepare and implement a plan to secure and brace all essential radios, antennas, and other communication and data processing equipment.

14. <u>RECOVERY</u>

Recovery efforts include all of the activities necessary to reestablish a community and normal activity following an earthquake. Recovery issues begin emerging during the early emergency response activities, and the process of reconstruction may continue for decades.

Plans for disaster response almost always focus on the first few days following an earthquake--the period in which lives have to be saved and emergency food and water supplies provided. The time it takes to rebuild a community is much longer. In the case of Tagshan, China, which was almost totally destroyed, reconstruction took twelve years. Experience indicated that all too often recovery plans are not made until the post-earthquake period, when there is widespread public demand for a quick return to "normal." As a result, plans are formulated in haste and little is done to prevent recreation of conditions as hazardous as those that existed previously. The normal reaction is to put the community back together the way it was, without stopping to think if the rebuilt area will be safe or if it should be rebuilt in a different configuration, or even in a different location.

Collapse or demolition of damaged buildings, which often are located in the economically depressed core of a community, can actually present an opportunity for renewal. Because of the demand for a quick return to normal, the opportunity for community revitalization may be lost unless there are recovery plans and reconstruction authority established <u>before</u> the confusing and traumatic period which always follows a major disaster. Recovery plans and reconstruction authority documents need to be detailed, the important thing is that they be prepared <u>before</u> the earthquake.

A short-term recovery plan should include:

- Permit streamlining procedures;
- Locations for temporary housing;
- A priority schedule for replacement of essential facilities and services.

It is important too for private companies to have recovery plans. They have responsibilities to provide goods and services to the public, to provide income to their employees and stockholders, and may have legal contractual commitments. A company that is doing business the next day gains an advantage over the competition and a valuable public relations benefit. In the private sector, the companies which provide computer services are among the best prepared because if they lose their data, they lose everything.

The State of California urges, but does not require, the cities and counties to prepare recovery plans. Most communities and most business do not have recovery plans. The City of Los Angeles plan was in the draft stages in June, 1989. The City of Santa Rosa had a redevelopment plan before the 1969 earthquake but was unable to resist pressures to rebuild the city the way it was. Coalinga had a redevelopment agency and redevelopment plan in place before the 1983 earthquake. This provided a much needed framework for rebuilding after the earthquake.

POLICIES ON RECOVERY

It is the Policy of the County of San Diego to:

1. Develop an adequate reconstruction authority, policy, and procedures in advance of a major emergency to effectively manage rebuilding and recovery operations after a major earthquake.

Action Programs

1.1 Establish a reconstruction authority to develop contingency plans and programs for post-disaster rebuilding and recovery.

1.2 Develop special zoning and building procedures to facilitate rebuilding after a disaster.

1.3 Prepare a redevelopment/recovery plan and apply it to the specific needs of each unincorporated community as part of the community plan update process.

1.4 Prepare an inventory of points of vulnerability and establish priorities for reestablishment of community services.

1.5 Prepare and adopt an ordinance which authorizes community construction beyond the time period of declared emergency.

2. Promote and support private business recovery plans.

3. Support federal and state legislation to develop an adequate earthquake insurance program that includes provisions for disaster relief and hazard-reduction incentives.